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GOVERNOR

STATE OF MAINE  
DEPARTMENT OF ENVIRONMENTAL PROTECTION



PATRICIA W. AHO  
COMMISSIONER

**Exeter Agri-Energy, LLC  
Penobscot County  
Exeter, Maine  
A-1047-71-C-A**

**Departmental  
Findings of Fact and Order  
Air Emission License  
Amendment #2**

**FINDINGS OF FACT**

After review of the air emissions license amendment application, staff investigation reports and other documents in the applicant's file in the Bureau of Air Quality, pursuant to 38 M.R.S.A., §344 and §590, the Maine Department of Environmental Protection (Department) finds the following facts:

**I. REGISTRATION**

**A. Introduction**

Exeter Agri-Energy, LLC (Exeter Agri-Energy) was issued Air Emission License A-1047-71-A-N on March 11, 2011, permitting the operation of emission sources associated with their anaerobic digester and electric generator facility. The license was subsequently amended on October 5, 2011 (A-1047-71-B-M) to update the back-up boiler information.

Exeter Agri-Energy has requested an amendment to increase the licensed sulfur dioxide (SO<sub>2</sub>) emission limit based on the results of biogas hydrogen sulfide (H<sub>2</sub>S) samples taken from the anaerobic digester outlet and to adjust the H<sub>2</sub>S monitoring requirements.

This amendment also clarifies the flare operations recordkeeping requirement, allowing for the option of using an automated system. Currently the flare operations are required to be logged manually.

The equipment addressed in this license is located at Stonyvale Farm at 226 Fogler Road, Exeter, Maine.

**B. Emission Equipment**

This air emission license amendment addresses the anaerobic digester outlet gas and emissions from the 1 megawatt (MW) cogeneration unit rated at 9.5 MMBtu/hr (15,767 scf/hr) firing biogas.

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C. Application Classification

The modification of a minor source is considered a major or minor modification based on whether or not expected emission increases exceed the "Significant Emission Levels" as defined in the Department's regulations. The emission increases are determined by subtracting the current licensed emissions preceding the modification from the maximum future licensed allowed emissions, as follows:

<u>Pollutant</u>	<u>Current License (TPY)</u>	<u>Future License (TPY)</u>	<u>Net Change (TPY)</u>	<u>Sig. Level</u>
PM	5.0	5.0	-	100
PM <sub>10</sub>	5.0	5.0	-	100
SO <sub>2</sub>	2.8	15.9	+13.1	100
NO <sub>x</sub>	22.3	22.3	-	100
CO	31.7	31.7	-	100
VOC	10.2	10.2	-	50
CO <sub>2</sub> e	n/a	<100,000		100,000

This modification is determined to be a minor modification and has been processed as such.

II. **BEST PRACTICAL TREATMENT (BPT)**

A. Introduction

In order to receive a license, the applicant must control emissions from each unit to a level considered by the Department to represent Best Practical Treatment (BPT), as defined in *Definitions Regulation*, 06-096 CMR 100 (as amended). Separate control requirement categories exist for new and existing equipment as well as for those sources located in designated non-attainment areas.

BPT for new sources and modifications requires a demonstration that emissions are receiving Best Available Control Technology (BACT), as defined in *Definitions Regulation*, 06-096 CMR 100 (as amended). BACT is a top-down approach to selecting air emission controls considering economic, environmental and energy impacts.

B. Background

Exeter Agri-Energy is a wholly owned subsidiary of Stonyvale dairy farm, which licensed and installed an anaerobic digester system to produce biogas fuel to power a 1 MW combined heat and electric cogeneration unit. The material input for the two parallel anaerobic digester units (1500 m<sup>3</sup> each) includes cow manure

from the approximately 1200 milking head equivalent farm and food processing wastes from outside sources. The facility obtained a solid waste facility license from the Department to accept off-site wastes.

The biogas-fired cogeneration unit is a 1475 horsepower (hp) spark-ignition internal combustion engine used to power the 1 MW electric generator. Waste heat captured from the generator is used to optimize the anaerobic digester temperature and to provide heat for other purposes. When the cogeneration unit is not available, the digester emissions are flared. The system began operations in December 2011.

**C. Sulfur Emissions**

Based on actual operating data, Exeter Agri-Energy has proposed to increase the licensed allowed SO<sub>2</sub> emissions from the facility. The licensed allowed SO<sub>2</sub> emission limits in air emission license A-1047-A-N were based on theoretical expectations.

SO<sub>2</sub> emissions from the cogeneration unit are formed during combustion oxidation of sulfur compounds present in the biogas produced by the anaerobic digesters. In order to reduce SO<sub>2</sub> emissions, Exeter Agri-Energy controls H<sub>2</sub>S emissions from the anaerobic digesters using an internal design system technology. This control system converts H<sub>2</sub>S to sulfate (SO<sub>4</sub>) by injecting a small percentage of air into the digester head space to biologically convert most of the H<sub>2</sub>S present in the digester gas zone to SO<sub>4</sub>. The SO<sub>4</sub> then precipitates out in the liquid effluent.

The control system was designed to theoretically keep H<sub>2</sub>S concentrations below 250 ppmv and this concentration was used to calculate the 2.3 tons per year SO<sub>2</sub> emissions limit found in air emission license A-1047-71-A-N (based on complete conversion of 250 ppm H<sub>2</sub>S and maximum biogas fuel use). It was estimated that without the control system, uncontrolled H<sub>2</sub>S emissions would be approximately 2000 ppmv. Although the current license does not have a specific H<sub>2</sub>S limit, it does have an SO<sub>2</sub> limit of 0.65 lb/hr (2.8 tons/year) which was based on the expected 250 ppmv H<sub>2</sub>S average.

The facility has been monitoring emissions with a hand-held analyzer and results have been highly variable. In April 2012, the H<sub>2</sub>S was averaging approximately 900 ppmv for digester #1 and 820 ppmv for digester #2. Specific data submitted to the Department for 24 samples on each of the two digesters in August and September 2012 resulted in H<sub>2</sub>S numbers ranging between 414 and 1800 ppmv. Levels as of March 2013 were in a lower 300-500 ppmv range.

1. BACT Findings:

The BACT determination for SO<sub>2</sub> emissions in the original licensing of the facility was the use of the internal design system technology to reduce biogas H<sub>2</sub>S and thereby reduce SO<sub>2</sub> emissions. The control system has not met the original expectations for H<sub>2</sub>S reduction and Exeter Agri-Energy has been actively working on the issue.

Exeter Agri-Energy submitted supplemental information to the amendment application in September 2012 describing the steps the facility has been taking to address H<sub>2</sub>S in the biogas, including: identifying the source(s) of the sulfur, determining whether the current H<sub>2</sub>S removal technology is working properly, and identifying other technologies that could be utilized for H<sub>2</sub>S reduction.

To identify the source(s) of the higher sulfur amounts, Exeter Agri-Energy tested the manure stream added to the anaerobic digesters. The silage, water, and bedding were tested for sulfur and although there were moderate levels of sulfur in the silage, the amount didn't appear to be excessive. The bedding material test results were lower than expected. While testing the manure stream, spikes in H<sub>2</sub>S continued to occur and although the off-site food waste materials were supposed to be tested and evaluated prior to adding them to the anaerobic digesters, Exeter Agri-Energy looked into the individual food sources. One source was found to be using sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) to remove free fatty acids from the glycerin. The supplier has agreed to start using a different chemical to remove the free fatty acids.

Exeter Agri-Energy focused on the oxygen delivery in the current H<sub>2</sub>S removal technology to determine if enough oxygen was being added to the head space of the digester. However, too much oxygen can result in explosive conditions. A second oxygen meter will be used to verify that the optimal level of oxygen is being delivered to the system.

Two other potential technologies available to remove H<sub>2</sub>S from biogas are a gas scrubber and an iron sponge type system. A gas scrubber would need to be installed after the digester and before the engine to clean and condition the gas. At this time, the scrubber technology does not appear cost effective based on high capital and operating costs per ton of SO<sub>2</sub> emissions controlled. The iron sponge system would involve adding ferric chloride to the cow manure before it is pumped to the digester, forming a bond with any sulfur in the manure. This may be a viable option depending on specific cost, storage, and chemical use for the facility, if needed in the future.

Exeter Agri-Energy has proposed an increase in licensed allowed SO<sub>2</sub> emissions as the facility continues to evaluate the anaerobic digester system and further reduce actual H<sub>2</sub>S levels. Exeter Agri-Energy has proposed an

H<sub>2</sub>S action threshold of 1400 ppmv when using the handheld monitor. At 1400 ppmv the facility would need to take immediate action to reduce the H<sub>2</sub>S levels from the anaerobic digesters. The licensed tons per year would be based on an annual average of 1400 ppmv H<sub>2</sub>S to allow for process variability, resulting in an annual SO<sub>2</sub> emission limit of 15.9 tpy.

Exeter Agri-Energy has also proposed clarification of the monitoring requirements. The current license condition 16(H) states:

(16)(H) Within 4 months of commencing operation and again at 12 months after commencing operation, Exeter Agri-Energy shall test a grab sample of anaerobic digester outlet gas (prior to the cogeneration unit inlet) and test for H<sub>2</sub>S and total sulfur. Additional testing shall be upon request. [06-096 CMR 115, BACT]

Exeter Agri-Energy has proposed to log H<sub>2</sub>S sampling of the biogas, using the handheld monitor or equivalent, at least once per calendar month to optimize the control system. Any monitoring results above 1400 ppmv H<sub>2</sub>S would require immediate corrective action. Also, Exeter Agri-Energy has proposed to conduct verification testing at least once per calendar year using American Society of Testing and Materials (ASTM) Test Method D5504 or other methods as approved by the Department to analyze for H<sub>2</sub>S and total sulfur.

Based on the information submitted and actual operations of the facility, the Department has determined that the BACT license requirements shall be revised to increase the cogeneration unit SO<sub>2</sub> emissions from 0.65 lb/hr to 3.63 lb/hr, the facility will be subject to more frequent testing than the current requirements, and an action threshold of 1400 ppmv H<sub>2</sub>S will be added to the license. In addition to monthly H<sub>2</sub>S sampling of the biogas with a handheld monitor, Exeter Agri-Energy shall also be required to test annually for H<sub>2</sub>S and total sulfur using ASTM Test Method D5504 or other approved methods to confirm the results of the handheld analyzer and verify compliance with the SO<sub>2</sub> emission limit. The flare SO<sub>2</sub> emission limit shall also be revised to 3.63 lb/hr.

## 2. Calculations

The following documents the calculations and conversions used to determine the SO<sub>2</sub> emission limits from the H<sub>2</sub>S value (assuming 100% conversion of H<sub>2</sub>S to SO<sub>2</sub>):

H <sub>2</sub> S in Digester Gas (ppmv)	ppmv converted to mg/m3	H <sub>2</sub> S conc. (lb/ft3)	Digester gas input (scf/hr)	H <sub>2</sub> S input rate (lb/hr)	Hourly SO <sub>2</sub> emissions (lb/hr)	Annual SO <sub>2</sub> emissions (tpy)
1400	1961.92	1.2248E-04	15,767	1.93	3.63	15.9

Conversions: H<sub>2</sub>S molecular weight: 34.8 g/mol  
SO<sub>2</sub> molecular weight: 64.06 g/mol  
Pounds per milligram (lb/mg): 2.2046E-6  
Cubic feet per cubic meter (ft<sup>3</sup>/m<sup>3</sup>): 35.315  
Digester gas heat value (AP-42 3.1-1 dated 4/2000): 600 Btu/scf

D. Flare Records

Exeter Agri-Energy has requested a revision to the flare recordkeeping requirement. Condition 18(E) in air emission license A-1047-71-A-N requires: "a log recording date, time, and duration of flare operations shall be maintained." Clarification language shall be added to Condition 18(E), allowing the flexibility to keep records manually or through an automated system, such as computer recordings from a thermocouple or gas flow meter associated with the flare.

E. Annual Emissions

1. Total Annual Emissions

Exeter Agri-Energy shall be restricted to the following annual emissions, calculated with the cogeneration unit operating 8760 hrs/year, the emergency generator operating 500 hrs/year, and the sawmill diesel drive unit operating 200 hrs/year, based on a 12 month rolling total:

**Total Licensed Annual Emissions for the Facility**  
**Tons/year**  
(used to calculate the annual license fee)

	<b>PM</b>	<b>PM<sub>10</sub></b>	<b>SO<sub>2</sub></b>	<b>NO<sub>x</sub></b>	<b>CO</b>	<b>VOC</b>
Cogeneration Unit*	5.0	5.0	15.9	21.4	31.3	10.0
Emergency Generator	0.04	0.04	0.0005	0.64	0.30	0.12
Sawmill Diesel Drive Unit	0.02	0.02	0.002	0.25	0.14	0.05
<b>Total TPY</b>	<b>5.0</b>	<b>5.0</b>	<b>15.9</b>	<b>22.3</b>	<b>31.7</b>	<b>10.2</b>

\* This is worst case scenario. The operation of the back-up flare/back-up boiler when the cogeneration unit is not available has the same or lower emissions as the cogeneration unit.

2. Greenhouse Gases

Greenhouse gases are considered regulated pollutants as of January 2, 2011, through 'Tailoring' revisions made to EPA's *Approval and Promulgation of Implementation Plans*, 40 CFR Part 52, Subpart A, §52.21 Prevention of Significant Deterioration of Air Quality

rule. Greenhouse gases, as defined in 06-096 CMR 100 (as amended), are the aggregate group of the following gases: Carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. For licensing purposes, greenhouse gases (GHG) are calculated and reported as carbon dioxide equivalents (CO<sub>2</sub>e).

Based on the facility's biogas firing rate, the worst case emission factors from AP-42, IPCC (Intergovernmental Panel on Climate Change), and *Mandatory Greenhouse Gas Reporting*, 40 CFR Part 98, and the global warming potentials contained in 40 CFR Part 98, Exeter Agri-Energy is below the major source threshold of 100,000 tons of CO<sub>2</sub>e per year. Therefore, no additional licensing requirements are needed to address GHG emissions at this time.

### III.AMBIENT AIR QUALITY ANALYSIS

The level of ambient air quality impact modeling required for a minor source shall be determined by the Department on a case-by case basis. In accordance with 06-096 CMR 115, an ambient air quality impact analysis is not required for a minor source if the total emissions of any pollutant released do not exceed the following levels and there are no extenuating circumstances:

<u>Pollutant</u>	<u>Tons/Year</u>
PM <sub>10</sub>	25
SO <sub>2</sub>	50
NO <sub>x</sub>	50
CO	250

The total facility licensed emissions are below the emission levels contained in the table above and there are no extenuating circumstances; therefore, an ambient air quality impact analysis is not required as part of this license.

### ORDER

Based on the above Findings and subject to conditions listed below, the Department concludes that the emissions from this source:

- will receive Best Practical Treatment,
- will not violate applicable emission standards, and
- will not violate applicable ambient air quality standards in conjunction with emissions from other sources.

The Department hereby grants Air Emission License A-1047-71-C-A subject to the conditions found in Air Emission License A-1047-71-A-N and amendment A-1047-71-B-M, and in the following conditions.

Severability. The invalidity or unenforceability of any provision, or part thereof, of this License shall not affect the remainder of the provision or any other provisions. This License shall be construed and enforced in all respects as if such invalid or unenforceable provision or part thereof had been omitted.

### **SPECIFIC CONDITIONS**

**The following shall replace condition (16) in air emission license A-1047-71-A-N:**

**(16) Cogeneration Unit**

A. The cogeneration unit (9.5 MMBtu/hr) shall fire biogas. [06-096 CMR 115, BPT]

B. Emissions from the cogeneration unit shall not exceed the following:

<b>Pollutant</b>	<b>lb/MMBtu</b>	<b>Origin and Authority</b>
PM	0.12	06-096 CMR 103(2)(B)(1)(a)

C. Emissions from the cogeneration unit shall not exceed the following [06-096 CMR 115, BPT]:

<b>PM (lb/hr)</b>	<b>PM<sub>10</sub> (lb/hr)</b>	<b>SO<sub>2</sub> (lb/hr)</b>	<b>NO<sub>x</sub> (lb/hr)</b>	<b>CO (lb/hr)</b>	<b>VOC (lb/hr)</b>
1.14	1.14	3.63	4.9	7.2	2.3

D. Visible emissions from the cogeneration unit shall not exceed 20% opacity on a six (6) minute block average, except for no more than two (2) six (6) minute block averages in a continuous 3-hour period. [06-096 CMR 101]

E. The stack for the cogeneration unit shall be a minimum of 20 feet in height. [06-096 CMR 115, BACT]

F. The cogeneration unit shall utilize timing retard to minimize emissions and shall keep records on site documenting the ideal settings for the unit. [06-096 CMR 115, BACT]



G. Exeter Agri-Energy shall keep records of the hours of operation of the cogeneration unit on a monthly and 12 month rolling total basis. [06-096 CMR 115, BACT]

H. Sampling, H<sub>2</sub>S Action Threshold, and Testing

1. Exeter Agri-Energy shall log H<sub>2</sub>S sampling of the biogas from each anaerobic digester at least once per calendar month using the handheld monitor or equivalent.
2. Exeter Agri-Energy shall take immediate action to reduce the H<sub>2</sub>S level from the anaerobic digester for any monitoring test result above 1400 ppmv H<sub>2</sub>S. A log shall be maintained describing the action taken. A follow-up sample result shall be taken and recorded after action is completed.
3. Exeter Agri-Energy shall conduct testing at least once per calendar year using ASTM Test Method D5504, or other methods as approved by the Department, to analyze for H<sub>2</sub>S and total sulfur. The facility shall log the results of the tests.
4. Concurrent with the annual test, measurements of H<sub>2</sub>S shall be taken with the handheld monitor, or equivalent. If the results of the handheld (or equivalent) sampling does not correspond within reasonable accuracy to the annual test results, Exeter Agri-Energy shall re-assess/replace/recalibrate the handheld monitor, or equivalent, as appropriate to obtain valid sampling results.

[06-096 CMR 115, BACT]

I. NSPS, 40 CFR Part 60, Subpart JJJJ

1. The cogeneration unit shall be equipped with a non-resettable hour meter. [40 CFR 60.4237 and 06-096 CMR 115, BACT]
2. The cogeneration unit is subject to emission requirements set forth in 40 CFR 60, Subpart JJJJ. Compliance with these emission requirements shall be demonstrated by certification from the manufacturer or an initial performance test and subsequent tests every 8760 hours of operation or 3 years, whichever comes first, if a manufacturer certification is unavailable. [40 CFR 60, Subpart JJJJ]
3. Exeter Agri-Energy shall meet all requirements of 40 CFR Part 60, Subpart JJJJ for the cogeneration unit.

**The following shall replace condition (18) in air emission license A-1047-71-A-N:**

**(18) Flare**

- A. The flare (9.5 MMBtu/hr) shall fire biogas and shall be operated when the cogeneration unit is off-line. [06-096 CMR 115, BACT]

B. Emissions from the flare shall not exceed the following:

Pollutant	lb/MMBtu	Origin and Authority
PM	0.12	06-096 CMR 103

C. Emissions from the flare shall not exceed the following [06-096 CMR 115, BACT]:

PM (lb/hr)	PM <sub>10</sub> (lb/hr)	SO <sub>2</sub> (lb/hr)	NO <sub>x</sub> (lb/hr)	CO (lb/hr)	VOC (lb/hr)
1.14	1.14	3.63	0.67	3.51	1.33

D. Visible emissions from the flare shall not exceed an opacity of 10% on a 6 minute block average basis, except for no more than one (1) six (6) minute block average in a 3 hour period. [06-096 CMR 115, BACT]

E. Records shall be maintained indicating the date, time, and duration of flare operations. Such records may be in the form of a written or electronic log. Acceptable records include, but are not limited to, relevant parameters such as flare temperature or flare gas fuel flow readings recorded by the computer control system. [06-096 CMR 115, BACT]

DONE AND DATED IN AUGUSTA, MAINE THIS 9 DAY OF July, 2013.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

BY:

*Maureen Allen Robert Cone* for  
PATRICIA W. AHO, COMMISSIONER

The term of this amendment shall be concurrent with the term of Air Emission License A-1047-71-A-N.

PLEASE NOTE ATTACHED SHEET FOR GUIDANCE ON APPEAL PROCEDURES

Date of initial receipt of application: June 15, 2012

Date of application acceptance: June 19, 2012

Date filed with the Board of Environmental Protection:

This Order prepared by Kathleen E. Tarbuck, Bureau of Air Quality.

